2010 CTPG 2020 Final Study Plan:

Phase 2

March 19, 2010

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1 Executive Summary

1.1 Background

The California Transmission Planning Group (CTPG) is a forum for conducting joint transmission planning studies consistent with Federal Energy Regulatory Commission (FERC) Order 890 principles, and for coordinating CTPG members' transmission planning activities. The CTPG members include both transmission owners and transmission operators and are subject to North American Electric Reliability Corporation (NERC)/Western Electricity Coordinating Council (WECC) transmission planning standards. The purpose of the 2010 CTPG 2020 Study is to develop a state-wide transmission plan that identifies the transmission infrastructure needed to reliably and efficiently meet, by year 2020, the state's 33% Renewable Portfolio Standard (RPS) goal. The 2010 statewide plan is intended to be truly conceptual, not prescriptive. The CTPG is not a generation or transmission project decision-making body. The conceptual plan will require further consideration and analysis by the CTPG members as part of their own respective approval processes.

As reflected in this Phase 2 study plan, CTPG has sought to be responsive to stakeholders and other entities with roles in the planning and implementation of transmission development, including the Renewable Energy Transmission Initiative (RETI) and state energy agencies. The CTPG will continue to utilize several stakeholder involvement forums to receive this valuable input.

1.2 Overview

Transmission planning generally consists of three main elements: an estimate of the load that is expected in the planning horizon; modeling of the supply resources that are, or will be, interconnected to the transmission grid; and the identification of alternative transmission facilities that can meet reliability, economic, and policy objectives, such as the RPS. The 2010 CTPG 2020 Study is drawing the information and methodological assumptions needed for transmission planning from several sources including California's RETI conceptual transmission plan that was developed to facilitate access to RETI-identified Competitive Renewable Energy Zones (CREZs), CTPG members, and other stakeholders. The CTPG will use this planning information and stakeholder input to conduct the analysis of a number of scenarios to enable the completion of a state-wide conceptual transmission plan that will provide a basis for "least regrets" decisions in the subsequent planning phases by CTPG members.

The CTPG has revised its processes to complete the 2010 CTPG 2020 Study in three phases. Phase 1 has been concluded. The Phase 1 study results were posted to the CTPG website in draft, presented formally to stakeholders, and received the benefit of stakeholder input. The final Phase 1 study report is now posted to the CTPG website. This Phase 2 Study Plan is designed to build on the work completed in Phase 1 and reflects stakeholder input by incorporating additional planning assumptions and scenarios to be studied in Phase 2 and Phase 3. The Draft Phase 2 Study Plan has been posted to the CTPG website and has been formally presented to stakeholders for input. The present document is the Final Phase 2 Study Plan and includes the incorporation of stakeholder input to date.

A. Study Scope

In evaluating the performance of the transmission system with increased levels of renewable resources, it is important to understand and prepare for what may happen under adverse system conditions, as well as during expected system conditions. In Phase 2, like Phase 1, the CTPG will conduct contingency-based power flow analysis and transient stability analysis of the grid configuration for the following cases that represent forecasted adverse and normal conditions:

Phase 2 like Phase 1 includes variations of the following cases:

- Case A: 2020 Northern California adverse weather (90/10) case
- Case B: 2020 Southern California adverse weather (90/10) case

Phase 2 will also include the following additional study cases

- Case F: 2020 California Autumn light weather originally planned for Phase 2 will be deferred to Phase 3
- Case OTC: Adverse weather case with identified "Once Through Cooling" resources off line

B. Grid Configuration

Like the Phase 1 studies, the Phase 2 studies will utilize the WECC's 2019 Heavy Summer (HS) case. This base case is the latest available data for the WECC interconnected system for the 2020 time frame. A WECC full-loop representation will be used that includes the Western United States, Western Canada and the system of Comisión Federal de Electricidad (CFE) of Baja California, Mexico. At the request of stakeholders, the WECC HS will be changed in Phase 2 to remove the Green Path Project which is no longer being considered by the LADWP and the addition of a recently approved third circuit to the Barren Ridge/Haskell Canyon/Renaldi planned upgrades.

C. Reliability Criteria

The CTPG will utilize NERC/WECC transmission planning standards to determine the list of potential transmission system violations that require mitigation. At this time, the CTPG will provide wire recommendations only. The CTPG will not be conducting a deliverability analysis to determine the necessary improvements and operating methodology for delivery of renewables to fulfill Resource Adequacy eligibility, and to provide integration capability for variable generation renewables, such as pumped storage or other methods. These types of analysis will be completed by the entity responsible for each particular proposed transmission improvement utilizing its own analysis assumptions. The CTPG may perform this type of analysis in future studies.

The CTPG will also not be performing an alternative analysis for mitigating the need for a new or upgraded transmission line with protection control systems in the 2010 study plan. This alternative analysis will be completed by the entity responsible for each particular proposed transmission improvement utilizing its own analysis assumptions and mitigation policies and practices. The CTPG may perform this alternative analysis in future studies.

D. Net Short Input Assumptions

In Phase 1, the CTPG members jointly identified the amount of renewable energy resource additions, the "net short", that will be required between 2010 and 2020 to meet the 33% RPS. In Phase 2, CTPG has worked with RETI to update estimates of other miscellaneous renewable resource additions and clarifying other differences in assumptions to update the "net short" estimates that will be applied to the renewable resource portfolios modeled in Phase 2. The CTPG will use a "net short" of 52,764 GWh for Phase 2 modeling.

E. Renewable Generation Portfolios

The CTPG recognizes that there remains uncertainty about the renewable generation portfolios that will be realized in 2020. To address this uncertainty, the CTPG will evaluate alternative renewable generation portfolios as a basis for determining the impact of those alternatives on the state-wide conceptual transmission plan. In response to stakeholder input, Phase 2 will evaluate two new renewable portfolios.

The first portfolio is a commercial interest portfolio of renewable generation based on the generation interconnection queues of CTPG members. This portfolio is referred to as the Generation Interconnection Queue Portfolio. For the CAISO queue, approximately 15,000 MW of resources were selected based on whether they have completed or are due to complete interconnection agreements or have otherwise posted financial security. The remainder of the CTPG planning entities, (IID, LADWP, SMUD, TANC, and TID), have selected approximately 3,000 MW of proposed projects that are considered to be the most advanced in the respective approval processes. In addition to the Generation Interconnection Queue Portfolio studies, the CTPG will also study several scenarios using the queue portfolio as a base. One scenario will study the potential addition of 5000MW of Solar Photovoltaic in the Owens Valley Area. Also in response to stakeholder input, the CTPG will study a "Northern" scenario and a "Desert Southwest" scenario. It is expected that these two portfolios will identify the impact on the state's transmission needs if some of the 33% RPS goal was achieved with additional renewable resources from northern California and out-of-state.

The second portfolio has been developed through consultation with RETI. For the Phase 2 Study, RETI has provided a "Heavy In-State" portfolio. This portfolio includes a "discounted core" of renewable energy resources with the remainder of the energy resources required to provide the "net short" comprising of 70% in-state and 30% out-of state energy resources. The "discounted core" consists of projects having power purchase agreements (PPAs) which have been approved by an appropriate regulatory entity *and* have filed an application for a permit to construct the project with appropriate permitting agencies. The in-state energy resources include Competitive Renewable Energy Zones (CREZ) in California evaluated by RETI as having the best estimated economic and environmental ranked scores. The out of state energy resources include CREZs evaluated by RETI as having the best economic ranked scores. The final energy attributed to each resource is computed on a pro rata basis for each CREZ included based on total estimated CREZ energy potential. The CTPG will continue to consult with RETI to develop additional resource portfolios to be studied in Phase 3.

F. Generation Re-Dispatch

As renewable generation production is increased to reach 33% RPS, an equal amount of fossil fuel generation is turned down (re-dispatched or decremented) to balance load in each period modeled. Phase 1 studies used heat rate as the basis for re-dispatch, with high heat rate units, turned down first. Generally the higher the heat rate the higher the cost to generate energy. Phase 2 will continue to utilize this re-dispatch methodology and will also consider a re-dispatch methodology based on fuel type & technology as a proxy for re-dispatch to minimize carbon emissions. Phase 1 employed a 70/30 split for the reduction of fossil fuel generation located within California and generation units located outside the state respectively. Phase 2 will continue with this assumption for both the heat rate and fuel type & technology methods. Phase 3 may investigate other proposed ratios for the in and out of state split for select cases.

G. Methodology Comparison to RETI

At the request of stakeholders, Section 6 of this study plan includes a comparison between the methodologies that were utilized by the RETI in their development of the RETI California conceptual transmission plan and the methods used by the CTPG.

2 Phase 2 Study Plan Overview

2.1 Objectives

The CTPG is committed to developing a conceptual California state-wide transmission plan to meet, by year 2020, the state's 33% RPS goal. This transmission plan will seek to leverage a diverse portfolio of renewable energy generation technologies including wind, geothermal, small hydro, biomass and solar thermal and solar photovoltaic available to supply projected electricity demand in California from now to beyond 2020.

As reflected in this Phase 2 study plan, CTPG has sought to be responsive to stakeholders and other entities with roles in the planning and implementation of transmission development, including the Renewable Energy Transmission Initiative (RETI) and state energy agencies.

An important further qualification of the CTPG process and the state-wide conceptual plan that is being developed is that CTPG is not a transmission or generation project decision-making body. Such decisions will be made by the relevant CTPG member entities in accordance with their own processes for such decisions. Thus the 2010 statewide plan is intended to be truly conceptual, not prescriptive, in line with the CTPG role as a forum for statewide collaboration on planning. As such, the CTPG regularly requests and utilizes information from its members and from other state agencies on renewable projects that represent a snapshot of their respective generation interconnection queue processes, and has sought to make assumptions on how to aggregate such projects into a portfolio that achieves a state-wide 33% RPS. This snapshot is only being used to facilitate studies to determine potential state-wide transmission needs.

2.2 Study Scope

The CTPG is developing a state-wide transmission plan using multiple renewable resource portfolios and generation re-dispatch scenarios to determine the transmission system improvements that are needed to support the state's 33% RPS and maintain the transmission system reliability in accordance with industry standards. The 2010 CTPG 2020 study will be conducted in three phases. Each phase is intended to build on the previous phase by refining and adding additional scenarios and assumptions and testing the sensitivity of these scenarios and assumptions. At the completion of the 2010 CTPG Study, the CTPG expects to provide a list of transmission system improvements that can provide the basis for "least regrets" renewable transmission planning to the respective CTPG planning entities. These entities will then conduct operational, deliverability, and alternative analysis utilizing their respective policies and practices.

The identification of transmission system improvements that may be required by an expected change in generation resources or the grid configuration begins with snapshot analysis of grid performance under forecast system conditions. The North American Electric Reliability Corporation (NERC) Standards TPL-001 through -003 requires that the transmission system be "planned such that the Network can be operated to supply projected customer demands and projected Firm (non-recallable reserved) Transmission Services, at all demand levels over the range of forecast system demands". The CTPG will address the potential violations of NERC/WECC reliability standards at the network level only. Potential violation at the local load center level will be reported in the study and addressed by the entity responsible for local load center reliability. For the initial phase of the CTPG work, on- and off-peak studies were conducted to help frame system needs while accommodating increased renewable resource development. In evaluating the performance of the transmission system with increased levels of renewable resources, it is important to understand and prepare for what may happen under adverse system conditions, as well as during expected system conditions. Adverse conditions include high load hours when solar output will be at peak levels. Adverse conditions may also occur during lower load hours when wind generation is high but the amount of on-line dispatchable generation is relatively low. By testing a range of possible resource scenarios, in each phase across these same cases, the most accurate statewide transmission plan will be developed.

Phase 2 like Phase 1 includes variations of the following cases that represent forecasted adverse and normal conditions:

- Case A: 2020 Northern California adverse weather (1-in-10 Northern California coincident with Southern California 1-in-2) case
- Case B: 2020 Southern California adverse weather (1-in-10 Southern California coincident with Northern California 1-in-2) case

Phase 2 will also include the following additional study cases

- Case F: 2020 California Autumn light weather originally planned for Phase 2 will be deferred to Phase 3
- Case OTC: Adverse weather case with identified "Once Through Cooling" resources off line

Cases A and B include those transmission additions that are in the WECC 2019 Heavy Summer seed case as well as certain transmission elements that will allow for the interconnection of new renewable resources. Case A and B assume that major upgrades are built including Midpoint-Devers-Valley, Tehachapi Segments 1-11, the Barren Ridge/Haskell Canyon/Rinaldi upgrades, upgrades in the Owens Valley.

The studies for the cases will be performed using the following general steps.

Step 0: Develop Benchmark Base Case

- WECC 2019 cases as seed for scenarios
- Reflect transmission system configuration expected in 2020
- Update California demand according to scenario
- Re-dispatch path flows according to scenario
- Perform detailed contingency analysis to confirm reliability criteria is met

Step 1: Add Renewable Projects

- Model renewable projects at 0 MW output – CAISO and POU queue projects
- Modify grid to provide CREZ connections – Gen-tie and collector lines
- Perform detailed contingency analysis to confirm reliability criteria is met
- Identify and review limiting constraints or violations

Step 2: Dispatch Renewable Projects

- Dispatch renewable projects to anticipated output for each scenario
- Decrease an equal amount of fossil fuel generation
- Perform detailed contingency analysis to meet reliability criteria
- Identify and review limiting constraints or violations
- Identify transmission additions that will mitigate identified reliability criteria violations. These additions may include elements of the RETI Phase 2A conceptual transmission plan.

The case nomenclature uses a letter designation for scenarios followed by a number representing the particular step. Case A0 for example would be Scenario A with the modeling required in Step 0.

Case A2 will assess additional transmission that will mitigate identified reliability criteria violations during a northern California 1-in-10 year peak coincident with a southern California 1-in-2 year peak assuming 33% RPS goals are met but without stressing path flows. Case B2 will assess additional transmission that will mitigate identified reliability criteria violations for a southern California 1-in-10 year peak coincident with a northern California 1-in-2 peak assuming 33% RPS goals are met but without stressing path flows. (Case F will be completed in Phase 3)

Case OTC is a sensitivity study to evaluate the transmission system impacts of the retirement of Once-Through Cooling (OTC) generators in northern and southern California. Case OTC utilizes the A and B cases as a starting point and then assumes that OTC units are off-line. Based on CAISO's presentation "Impacts on Electric System Reliability from Restrictions on Once-Through Cooling in California" in November 2008,[1] the OTC generation plants in CAISO control area are as follows:

Table 2.1: Once Through Cooling Generation Reductions

Area	OTC Units Off Line
Northern California (Excluding Diablo Canyon Nuclear Plant) Total 5,499 MW	Humboldt – 105MW Contra Costa – 674MW Pittsburg – 1311MW Potrero – 206MW

[1] Available at http://www.caiso.com/208b/208b8ac831b00.pdf.

Area	OTC Units Off Line
	Morro Bay – 673MW Moss Landing – 2530MW
Southern California (Excluding San Onofre Nuclear Plant) Total 8,516 MW	Alamitos – 2010MW El Segundo – 670MW Encina – 950MW Huntington Beach – 904MW Mandalay – 430MW Ormond Beach – 1516MW Redondo Beach – 1343MW South Bay – 693MW
Los Angeles Basin (LADWP)	Haynes –1650 MW Harbor – 231 MW Scattergood – 818 MW

With these resource assumptions, Case OTC will assess additional transmission needs that will mitigate identified reliability criteria violations for a northern and southern California 1-in-10 year peak assuming 33% RPS goals are met without stressing path flows.

Cases A, B, and OTC may also identify certain Category C reliability criteria violations and that further study is required to identify suitable mitigation, such as controlled load drop and/or generator tripping, for these conditions. However, the CTPG has decided it will not evaluate the feasibility of such operation measures (See Section 3.1 Reliability Criteria for this discussion.) It is important to note these cases do not assess deliverability of off-peak conditions.

2.3 Grid configuration

Similar to Phase 1, the Phase 2 studies will be performed using the WECC's 2019 Heavy Summer case. This case is the latest available data for the WECC interconnected system for the 2020 time frame. A WECC full-loop representation will be used; and includes the Western United States, Western Canada and the system of Comisión Federal de Electricidad (CFE) of Baja California, Mexico.

As part of the study process some adjustments are anticipated between phases. For Phase 2 the following adjustments are to be implemented:

- Removal of the proposed Green Path North project. LADWP has stated that this project will not be pursued.

- The addition of a recently approved third circuit to the Barren Ridge/Haskell Canyon/Renaldi planned upgrades.

Table 2.2 lists the major transmission upgrades in the seed 2019 WECC Base Case that were assumed in-service for all CTPG cases in this study and subsequent additions and subtractions.

Table 2.2: Transmission Upgrades included in the 2019 "Heavy Summer" Seed Case and Transmission Additions/Subtractions made to the Seed Case

Upgrades with Key Regulatory Approvals and Environmental Permits	Upgrades without Key Regulatory Approvals and Environmental Permits	Upgrades Removed
-Tehachapi Segments 1-3 - Sunrise Powerlink project -Tehachapi Segments 4-11	- New Colorado River ("Midpoint") 500 kV substation looping in existing 500 kV Palo Verde-Devers #1 line. - 500 kV Colorado River-Devers #2 line - 500 kV Devers-Valley #2 line - Expand Barren Ridge 230 kV substation. Upgrade existing 230 kV Owens Gorge-Rinaldi line from Barren Ridge to Haskell Canyon with double circuit 230 kV towers. Add Barren Ridge-Haskell Canyon #2 line on open side of towers - Upgrade existing 230 kV Owens Gorge-Rinaldi line from Haskell Canyon to Rinaldi - Add 230 kV Castaic-Haskell Canyon #2 line on open side of towers - Loop existing 230 kV Coachella Valley-Devers line into Mirage substation creating 230 kV Mirage-Devers #2 line. - Reconductor 230 kV Mirage-Devers #2 line from 393 MVA to 494 MVA.	Green Path North

3 General Guidelines and Criteria

The CTPG will conduct contingency-based power flow analysis for the cases described in the previous section. The General Electric Positive Sequence Load Flow program (GE-PSLF) will be used in conjunction with in-house Engineer Programming Control Language (EPCL) routines to help analyze the study results.

3.1 Reliability Criteria

The Phase 2 study will use the following study methodology and criteria:

1. In the pre-contingency state and with all facilities in-service, the Bulk Electric System (BES) shall demonstrate transient, dynamic, and voltage stability. Facility ratings shall not be exceeded and uncontrolled separation shall not occur.

2. Starting with all facilities in-service and following single and double contingencies, the BES shall demonstrate transient, dynamic, and voltage stability. Facility ratings shall not be exceeded and uncontrolled separation shall not occur.
3. The single contingency analysis shall meet requirements R2.2 and R2.3 of NERC Reliability Standard FAC-010-1.
4. The double contingency analysis shall meet the requirements R2.4 and R2.5 and Regional Differences E.1 of FAC-010-1.

NERC Standard FAC-010-1 (E.1 R.1.2.5) provides that for double contingencies, the controlled interruption of electric supply (load shedding), the planned removal of certain generators (generation dropping), and/or the curtailment of firm power transfers may be necessary to maintain the overall security of the interconnected transmission system. These system adjustments can be made either manually or automatically via protection control systems. The CTPG will not be performing an alternative analysis for mitigating the need for a new or upgraded transmission line with protection control systems in the 2010 study plan. This alternative analysis will be completed by the entity responsible for each particular proposed transmission improvement utilizing its own analysis assumptions and mitigation policies and practices. The CTPG may perform this type of analysis in future studies.

Similarly, the CTPG will not be conducting a deliverability analysis to determine the necessary improvements and operating methodology for delivery of renewables to fulfill Resource Adequacy eligibility, and to provide integration capability for variable generation renewables, such as through pumped storage or other methods. This analysis will be completed by the entity responsible for each particular proposed transmission improvement utilizing its own analysis assumptions. The CTPG may perform this type of analysis in future studies.

All Facilities must be operating within their applicable post-contingency thermal, frequency, and voltage limits. The only exceptions to remaining within applicable ratings are: 1) a common mode outage of two generating units connected to the same switchyard and 2) the loss of multiple bus sections as a result of bus-tie breaker failure or delayed clearing due to a single line to ground fault.

For double contingency analysis, the CTPG will monitor all elements at 200 kV and higher, plus any additional critical lower voltage elements to determine potential reliability standards violations. Study results will document all elements that demonstrate a thermal loading of the facility applicable rating at 100% and above.

The NERC/WECC standards provide a framework from which computer simulation studies will be performed to model forecasted system conditions and evaluate the system performance. The following standards will be used for reliability assessments and standards compliance:

1. NERC Reliability Standards
    - TPL-001: System Performance Under Normal Conditions
    - TPL-002: System Performance Following Loss of a Single BES Element
    - TPL-003: System Performance Following Loss of Two or More BES Elements
2. WECC
    - Reliability Criteria For Transmission System Planning

   - Voltage Stability Criteria, Under voltage Load Shedding Strategy, and Reactive Power Reserve Monitoring Methodology
3. Each member's and balancing authority's specific planning criteria

3.2 Power Flow Contingency Analysis Guidelines

Power flow contingency analysis will be performed for each scenario consistent with the standards referenced in the previous section to identify thermal overload conditions. Note that additional contingencies may be added based upon engineering judgment for particular runs.

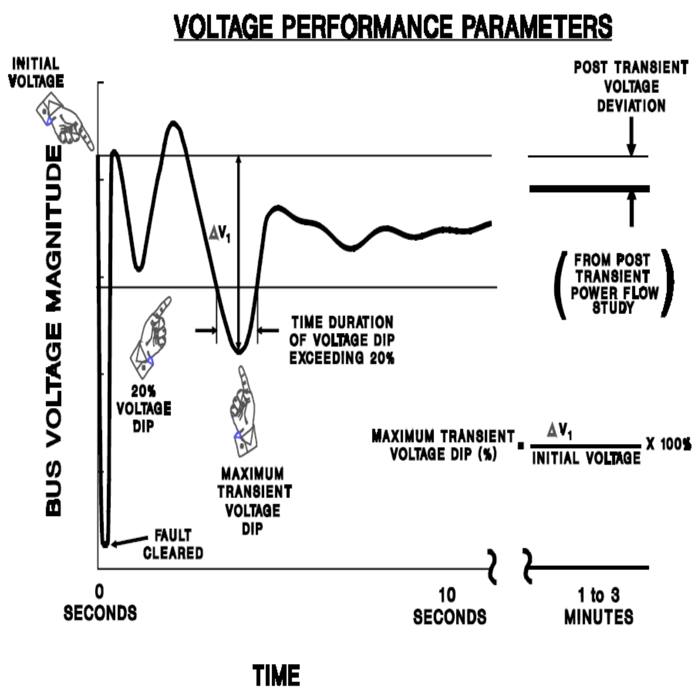
3.3 Transient Stability Analysis Guidelines

Transient stability studies will be performed to establish stability transfer limits and ensure system stability following a critical fault on the system and to facilitate the development of the dynamic voltage support requirements, if required.

- Machine Representation
  - For the stability analysis, resources consistent with the time period studied will be dispatched to meet the load requirements in the base cases. Representation of turbine generators will be consistent with available turbine generator data. The base case power system stabilizers that are normally in-service within the WECC system will be modeled for the Heavy Summer operating period studied. For new generator technologies that do not yet have specific representations, the study group will make reasonable assumptions and select the closest existing generator representation.
- Load Representation
  - Studies will be conducted with at least 20% of the total load represented in the WECC system as induction motor load.
- System Disturbances
  - All N-1 and credible N-2 system disturbances will be simulated.
- Fault Clearing Time
  - Faults on the transmission lines being evaluated will be cleared in accordance with guidelines provided by the facility owners.
- Under frequency Load-Shedding Simulated
  - The frequency will be monitored at key buses. If any stability run causes the frequency to drop sufficiently such that relays will "pick up", the under frequency load-shedding data will be reviewed and updated as necessary.
- Series Capacitors
  - Series capacitor modeling during transient conditions is indicated by the switching sequences.
- Unit Tripping
  - Unit tripping of other utility generation and pumping loads on under-frequency will be modeled in accordance with WECC guidelines or those provided by the appropriate facility owner.
- Generator Voltage Ride Through
  - Generator voltage ride through as per the WECC regional standard.
- Evidence of System Stability: The following WECC Disturbance-Performance criteria will be used:

WECC DISTURBANCE-PERFORMANCE TABLE
OF ALLOWABLE EFFECTS ON OTHER SYSTEMS

NERC and WECC Categories	Outage Frequency Associated with the Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard	Post Transient Voltage Deviation Standard (See Note 2)
A	Not Applicable	Nothing in addition to NERC		
B	≥ 0.33	Not to exceed **25%** at load buses or **30%** at non-load buses. Not to exceed **20% for more than 20 cycles** at load buses.	Not below **59.6** Hz for 6 cycles or more at a load bus.	Not to exceed **5%** at any bus.
C	0.033 – 0.33	Not to exceed **30%** at any bus. Not to exceed **20% for more than 40 cycles** at load buses.	Not below **59.0** Hz for 6 cycles or more at a load bus.	Not to exceed **10%** at any bus.
D	< 0.033	Nothing in addition to NERC		



3.4 Voltage Stability Analysis Guidelines

Post-transient studies will be performed to ensure the WECC Voltage Stability Criteria will be met following credible outages within the system. Certain contingencies may activate Remedial Action Schemes (RAS)/Special Protection Schemes (SPS) which will be included in the switching sequences as appropriate. The post-transient voltage deviations shall meet the WECC/NERC Planning Standards except for SCE area which allows 7% voltage drop for N-1 contingencies.

The following assumptions apply to post-transient voltage stability studies:

- All loads will be modeled as constant MVA during the first few minutes following an outage or disturbance.
- Remedial actions such as generator dropping, load shedding and blocking of automatic generation control (AGC) will be considered as appropriate.
- Shunt capacitors (132 MVAR) at Adelanto and Marketplace will be used if the post-transient voltage deviation exceeds 5% at those buses. Although modeled as shunt capacitors the actual devices are automatically controlled SVCs.
- Shunt capacitors in the SCE service area will be modeled according to the SCE Centralized Grid Capacitor Control to be provided by SCE.
- All automatic switching will be allowed if the switching action can be completed within the post-transient study time frame.

4 Input Assumptions

This section describes the key input assumptions to the Phase 2 study plan, including updates to the CTPG aggregate renewable energy planning target (net short), CTPG members' peak demands, and the new renewable generation portfolios and sensitivities to be studied.

4.1 Updates to the 2020 Renewable Energy Planning Target (Net Short)

In Phase 1, the CTPG identified the amount of renewable energy resource additions, "net short", that will be required between 2010 and 2020 to meet the 33% RPS goal for the state of California.[2] Further description of these assumptions is available in the CTPG Phase 1 study plan and final report. In Phase 2, CTPG has worked with RETI to update estimates of other miscellaneous renewable resource additions and clarifying other differences in assumptions to update the net short estimates that will be applied to the renewable resource portfolios modeled in Phase 2.

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[2]In Phase 1, CTPG used the 2020 energy forecast of the CEC's 2009 Integrated Energy Policy Report (IEPR), which resulted in an estimated 289,697 GWh of retail load in the state of California subject to the state's renewable goal. Under that assumption, assuming a 33% RPS goal in year 2020, load serving entities would be required to obtain a total of 95,600 GWh of renewable energy in order to meet the target, of which approximately 53,605 GWh would be acquired from resources over and above existing and new renewables and other miscellaneous additions – the net short. This net short requirement is now being modified in Phase 2, as described in this section and shown in the third and fourth column of Table 2.

Table4.1 compares CTPG's Phase 1 study estimated renewable energy production and net short with the 2009 RETI Phase 2A calculation which utilized a prior CEC demand forecast for 2020, and hence is higher than the more recent CEC forecast used for the CTPG Phase 2 RETI "Heavy In-State" and CTPG Generation Queue estimates that will be used in the Phase 2 studies. Note that the energy and peak load numbers provided below reflect the CEC's projection of the impact of the California Solar Initiative (CSI), and other behind-the-meter distributed generation, on retail loads. To the extent any of CTPG's Phase 2 scenarios assume larger behind-the-meter impacts from distributed generation, or includes other in-front-of-the meter distributed generation, modeled loads in the power flow cases will be reduced accordingly.[3]

Table 4.1: CTPG 2020 RPS Planning Targets Including Net Short (GWh) with comparison to RETI Phase 2A

	CTPG Phase 1	**RETI Phase 2A**	**CTPG Phase 2 RETI Heavy In State**	**CTPG Phase 2 Gen Queue**
Forecast Retail Load subject to California's renewable goals:	289,697	301,974	285,734	285,734
Renewable Portfolio Standard (RPS) Goal:	33%	33%	33%	33%
Renewable Portfolio Standard (RPS) Energy Requirement:	95,600	99,651	94,293	94,293
Existing and New Renewables expected to be on line by end of 2009:	39,324	36,807	38,174	38,174
Miscellaneous renewable resource additions:	2,670	3,134	3,355	3,355
Total Existing and New Resource Additions	**41,994**	**39,941**	**41,529**	**41,529**
Net Short:	**53,605**	**59,710**	**52,764**	**52,764**
Identified Renewable Resource Additions:	55,535	95,536*	52,764	52,764
Total Renewable Energy Production:	97,530	135,477*	94,293	94,293
Identified Renewable Energy as a Fraction of Retail Sales:	33.7%	44.9%*	33%	33%

[3] As noted elsewhere in this document, distributed generation poses modeling challenges that will eventually need to be addressed. For now, CTPG intends to simply model distributed generation by reducing loads.

*For purposes of developing a conceptual transmission plan that addresses uncertainties in the location of renewable resource development, RETI Phase 2A planned for renewable resource additions equal to approximately 1.6 times the RETI Phase 2A net short.

4.2 Peak Demand

In Phase 1, CTPG used peak demand forecasts for "1-in-2" and "1-in-10" summer weather conditions in 2020 provided by the individual members. In Phase 2, the scenarios modeled will use the assignments to each area used in the CEC IEPR 2009 forecast for peak demands consistent with the assumptions of the CTPG renewable net short calculation.[4]

Table 4.2 provides the data from the CEC peak demand forecasts for year 2020 for the Northern California Peak and the Southern California Peak. The Northern California Peak Demand includes the Northern California 1-in-10 year peak demand coincident with the Southern California 1-in2 year peak demand. The Southern California Peak includes the Southern California 1-in-10 year peak demand coincident with the Northern California 1-in2 year peak demand. The adjusted Northern and Southern California Peak Demands consists of the CEC Peak Demand Forecasts excluding: pump loads, forecasted distributed generation (Digester and Landfill Gas, Small Hydro, PV, and other small capacity generation) assumed by RETI, and transmission losses.

Table 4.2: CTPG Phase 2 Year 2020 Peak Demand (MW) based on CEC 2009 forecast

Area	CEC Northern California Peak Demand	Adjusted Northern California Peak Demand	CEC Southern California Peak Demand	Adjusted Southern California Peak Demand
PG&E	26,423	24,606	24,626	22,924
TID BA	829	802	776	749
SMUD BA	5,679	5,450	5,196	4,972
SCE	26,875	25,127	29,359	27,604
SDG&E	5,157	4,937	5,673	5,435
LADWP BA	6,912	6,335	7,501	6,917
IID BA	1,256	1,253	1,354	1,349
Total	73,132	68,511	74,485	69,951

[4] Available at http://www.energy.ca.gov/2009publications/CEC-200-2009-012/CEC-200-2009-012-SF-REV.PDF

4.3 Renewable Generation Portfolios

CTPG recognizes that there remains uncertainty about the renewable generation portfolios that will be realized in 2020 under the State's RPS. To address this uncertainty, CTPG will evaluate several alternative renewable generation portfolios as a basis for determining the impact of those alternatives on the state-wide conceptual transmission plan. This section reviews the portfolio used in Phase 1 and then describes additional portfolios that will be examined in Phase 2. CTPG will consult further with stakeholders, RETI, and state agencies to determine additional portfolios for consideration in Phase 3.

Review of CTPG Phase 1 Renewable Generation Portfolio

In Phase 1, load serving entities supplying the majority of California retail loads provided renewable procurement scenarios reflecting anticipated plans, installed capacity, and in some cases the expected renewable dispatch at the time of peak. In other cases CTPG used generic factors to relate nameplate capacity to expected renewable dispatch for the hour of study (e.g., peak hour, off-peak hour). These generic factors were taken from energy output profiles prepared for each of RETI's CREZs by technology for the specific hour and month. These hourly and monthly output profiles were also used to determine the forecasted annual energy generation estimate in the year 2020 by CREZ- and technology. Rooftop PV and other distribution-level generation were considered as a reduction to load.

The renewable procurement scenarios upon which CTPG's initial study work was based reflect a quantity and pattern of renewable resource development that is not the same as that used by RETI to develop its Phase 2A conceptual transmission plan.[5] The two portfolios are compared in Table 4, below. In Phase 2A, RETI developed its estimates based on economically feasible renewable development potential, not on actual commercial interest in that potential. In contrast, the CTPG Phase 1 procurement plans – which to some degree are based on signed Power Purchase Agreements (PPAs) – suggest that the actual quantities, mix and location of renewable resource additions may be significantly different than what was developed by RETI.[6] Also, RETI considered out-of-state renewable resource development potential in British Columbia, Washington, Oregon, Nevada, Arizona and Baja. As is evident from the data collected by the CTPG, California load serving entities' plans also include adding renewable resources located in Idaho and Montana.

[5] The RETI data was developed at the direction of the RETI Stakeholder Steering Committee and reflects: (1) RETI's Phase 2A identified renewable "net short," (2) the desire of utilizing, on a comparable basis, all of the identified CREZs to meet the "net short", and (3) the RETI Stakeholder Steering Committee's decision to adjust the RETI-identified economically feasible renewable resource development potential to approximate a 1.6 times the RETI "net short" quantity of renewable energy. According to RETI, this adjustment is a "success factor" adjustment. CTPG did not adjust or modify any of the reported RETI data. As described above, the CTPG renewable resource data was supplied by load serving members of the CTPG.

[6] Not all entities serving retail loads in California that are subject to California's renewable resource goals supplied renewable procurement plans to CTPG. CTPG's draft Phase 1 report lists those load serving entities that supplied renewable procurement plans to CTPG, and those that did not.

Phase 2 -- Generation Interconnection Queue-based Portfolio

Phase 2 introduces a different form of commercially-based renewable portfolio, based on generation interconnection queues. As shown in Table 4, this portfolio is different both from CTPG Phase 1 and from RETI Phase 2A. Each new generation project seeking to inject power into a transmission system must go through an interconnection process. This section provides some background on generation interconnection to explain the selection of the renewable resources identified in this portfolio.

The interconnection process generally serves two central functions. First, it identifies the equipment additions and upgrades necessary to provide the new generation facility with the level of transmission service it has requested and to ensure that the addition of the new generation facility will not degrade or otherwise negatively impact system reliability. Second, the interconnection process allocates the cost responsibility for the infrastructure identified during the interconnection studies. In order to accomplish these functions in an orderly and non-discriminatory manner, transmission providers utilize an interconnection queue. The process culminates in the execution of an interconnection agreement that covers relevant items such as the construction schedule for transmission facilities and other operational requirements.

The rules and requirements governing the interconnection process, including the queue, are established by FERC for the California ISO as well as those municipal utilities that utilize the transmission service offered by the ISO and provide reciprocal transmission service to ISO utilities. In 2003, FERC required greater standardization for interconnecting generation facilities larger than 20 MW (called Large Generation Interconnection Procedures, or LGIP); while similar rules were established for generators below that size (Small Generation Interconnection Procedures, or SGIP).[7] As such, the ISO and many municipal utilities apply interconnection procedures based upon these requirements, as well as subsequent modifications to facilitate the interconnection process.[8]

In response to stakeholder input, the Phase 2 commercial interest approach will utilize the renewable generation interconnection queues of CTPG members. The criteria that will be used for the CAISO queue will be to include projects they are in the following stages in their interconnection process:

1. For Serial interconnection studies (LGIP and SGIP) – All renewable projects with all interconnection studies completed and that have either signed or are in process of signing their interconnection agreement.
2. All remaining renewable projects in the ISO Transition Cluster (after posting of financial securities).

[7] Order No. 2003, 104 FERC ¶ 61,103 (2003) [18 CFR Part 35]. The ISO rules for large generation interconnection is in Appendix Y of the CAISO Tariff; available at http://www.caiso.com/2495/2495959721820.pdf

[8] Generation projects in the ISO queue that have progressed through the system impact study or beyond under the serial approach are referred to as the Serial Group. Generation Projects assigned to the first cluster are referred to as the Transition Cluster and any projects received in subsequent clusters will be evaluated through a standard annual process.

These criteria were chosen both to limit the set of resources needed to achieve 33% RPS, and to focus on projects that are in the most advanced state of development or have otherwise demonstrated the highest financial commitment. For the CAISO queue, approximately 15,000 MW of resources were selected based on the above criteria. Phase 2 will also add the proposed renewable generation projects and associated transmission for renewable energy projects from the other CTPG planning entities (IID, LADWP, SMUD, TANC, and TID) to make up the balance of the 33% RPS. These projects consist of approximately 3000 MW of installed renewable capacity. These projects as shown in Table 4.3 are considered by the respective planning entities to be the most advanced in their respective approval processes.

The aggregate of the CAISO queue projects and the other state planning agency projects resulted in a 35% RPS. Therefore the CTPG has scaled down all queue projects equally so that the aggregate of all proposed projects equals 33%. The CTPG recognizes that this scenario is limited to approximately 8% of energy generated from out-of-state. However, other scenarios planned for study in Phase 2 will study larger import levels and the associated impacts.

The resulting MW and GWhs by CREZ as compared to Phase 1, RETI Phase 2A, and the RETI Heavy In-State Portfolio are identified in Table 4.3. The resulting MW and GWhs for each CREZ and by technology are included in Table 4.4.

CTPG notes that the generation interconnection queues are continuously updated, as generators enter and leave the queue and as interconnection studies move forward. Therefore, updated studies will continue to be performed by the CTPG and its members to reflect these changes and the effect on the state-wide transmission plan.

RETI-Based 33% RPS Portfolios

In preparation of the Phase 2 Study Plan, the CTPG has worked with RETI to identify additional renewable generation portfolio scenarios that reflect expected development activity utilizing criteria approved by the RETI Stakeholder Steering Committee (SSC). The SSC is developing several such scenarios for initial study.[9] RETI has provided one scenario, the RETI "Heavy In-State Scenario", for assessment in Phase 2. It is expected that other RETI scenarios will be analyzed in Phase 3.

For some of these scenarios, RETI has adopted scenario definition concepts under development by the California Public Utilities Commission (CPUC) for use in its long-term procurement plan (LTPP). The key element is the inclusion of a "discounted core" consisting of projects deemed most likely to be operational by 2020. In the interest of making RETI scenarios similar to those likely to be used by CPUC, some proposed RETI scenarios also include "discounted core" projects.[10]

[9] Discussion of these scenarios can be found at http://www.energy.ca.gov/reti/steering/2010-02-26_meeting/documents/2010-02-26_Renewable_Generation_Scenarios_for_CTPG.pdf.
[10] See http://www.energy.ca.gov/reti/steering/2010-01-19_meeting/documents/07-LTPP-RPS%20Portfolios%202010-01-19.pdf.

The major features of the RETI scenario for CTPG Phase 2 are:

1. Total annual renewable energy generation requiring transmission access is equal to the RETI "net short", a value of 52,764 GWh.[11] As noted above, this value is being used by CTPG for its other Phase 2 scenarios as well.
2. Renewable generation included in the scenario was identified from three categories:
    a. A "discounted core" consisting of projects having power purchase agreements (PPAs) which have been approved by an appropriate regulatory entity *and* have filed an application for a permit to construct the project with appropriate permitting agencies;
    b. Competitive Renewable Energy Zones (CREZ) in California having estimated economic and environmental ranking scores lower than median California scores;
    c. Out of state CREZ having economic scores lower than the median out-of-state economic score (RETI has not attempted to compare environmental attributes of out-of-state areas);
3. Energy needed in addition to the discounted core to satisfy the net short was:
    a. Divided 70/30 between in- and out-of-state areas
    b. Computed on a pro rata basis from CREZ included based on total estimated CREZ energy potential.

The resulting MW and GWhs by CREZ as compared to Phase 1, RETI Phase 2A, and the Generation Interconnection Queue Portfolio are identified in Table 4.3. The resulting MW and GWhs for each CREZ and by technology are included in Table 4.5. CTPG will continue working with RETI to determine which of the additional RETI scenarios, or others, could be evaluated in Phase 3.

[11] See http://www.energy.ca.gov/reti/steering/2010-01-19_meeting/documents/04-Net%20Short%20Draft%202010-01-18.pdf.

Table 4.3: Comparison of Renewable Generation Portfolio for CTPG Phase 1, RETI Phase 2A, CTPG Phase 2-Generation Queue and RETI Heavy In-State

	CTPG Phase 1 Portfolio		RETI Phase 2A Portfolio*		CTPG Phase 2 Portfolio			
CREZ	LSE Commercial Interest Installed Capacity (MW)	LSE Commercial Interest Annual Renewable Energy Production (GWh)	RETI Projected Installed Capacity (MW)	RETI Projected Energy Production (GWh)	Generation Queue Installed Capacity (MW)	Generation Queue Annual Renewable Energy Production (GWh)	RETI Heavy In-State Installed Capacity (MW)	RETI Heavy In-State Annual Renewable Energy Production (GWh)
Barstow	850	1985	617	1546	0	0	0	0
British Columbia	0	0	0	0	0	0	0	0
Carrizo North	0	0	422	896	718	1532	0	0
Carrizo South	1545	3429	1024	2197	228	510	760	1616
Cuyama	0	0	211	471	37	78	0	0
Fairmont	345	862	929	2734	0	0	1126	2974
Humbolt	11	82	0	0	0	0	0	0
Imperial East	15	43	429	1045	0	0	0	0
Imperial North-A	352	2775	1370	10626	546	4305	631	4456
Imperial North-B	386	1843	483	1190	418	901	0	0
Imperial South	466	1091	981	2420	2101	4990	300	648
Inyokern	242	467	642	1669	483	2552	0	0
Iron Mountain	0	0	1297	3065	0	0	0	0
Kramer	344	988	1693	4370	41	326	2724	6280
Lassen North	873	2262	387	999	463	3652	0	0
Lassen South	0	0	108	292	0	0	0	0
Mountain Pass	768	1777	438	1145	656	1475	310	800
Needles	0	0	122	313	0	0	0	0
Owens Valley	0	0	370	954	184	399	0	0
Palm Springs	147	500	203	685	183	624	37	118

Pisgah	3248	7763	673	1658	781	1867	500	1047
Riverside East	1562	3471	2785	6725	2527	5615	0	0
Round Mountain-A	0	0	101	710	94	253	163	1086
Round Mountain-B	78	319	49	196	0	0	103	303
San Bernardino - Baker	825	1870	969	2299	0	0	0	0
San Bernardino - Lucerne	174	560	800	2150	0	0	42	96
San Diego	23	171	0	0	0	0	0	0
San Diego North Central	0	0	74	195	24	51	0	0
San Diego South	0	0	179	508	332	939	308	935
Santa Barbara	92	249	114	312	110	299	83	280
Solano	408	1248	236	756	587	1953	2	5
Tehachapi	3868	10189	5514	15716	5633	15397	6026	15804
Twentynine Palms	0	0	477	1219	0	0	0	0
Victorville	0	0	432	1128	312	768	0	0
Westlands	0	0	0	0	0	0	0	0
Arizona	333	740	0	0	0	0	2048	5240
Baja	0	0	5000	16966	1029	2704	0	0
British Columbia	0	0	340	1849	0	0	0	0
Idaho	130	350	0	0	0	0	668	2352
Montana	413	1111	0	0	0	0	0	0
New Mexico	0	0	0	0	544	0	0	0
Nevada	456	2388	466	3446	0	1574	727	2476
Oregon	1637	4408	392	3062	0	0	1349	3921
Utah	0	0	0	0	0	0	255	905
Washington	963	2594	0	0	0	0	447	1422
Wyoming	0	0	0	0	0	0	0	0
Total	**20554**	**55535**	**30327**	**95536**	**18031**	**52764**	**18609**	**52764**

* For purposes of developing a conceptual transmission plan that addresses uncertainties in the location of renewable resource development, RETI planned for renewable resource additions equal to approximately 1.6 times the RETI net short.

Other Renewable Generation Portfolios

The modeling of additional out of state renewables in Phase 2 was an explicit concern of stakeholders. It is assumed that load serving entities will replace portions of their existing fossil out of state contracts with new renewable contracts, or that renewable energy will displace some fossil energy in current portfolios. In addition, the CTPG will also study the potential addition of a large Solar Photovoltaic facility in the Owens Valley area. The Generation Interconnection Queue Portfolio will be used as the base for both the out-of-state scenarios and the Owens Valley scenario.

1. Northern and Desert Southwest Scenarios

Phase 2 will include two additional renewable resource scenarios that will include out of state renewable resources. These scenarios are the “Northern” scenario and a “Desert Southwest” scenario. It is expected that these two scenarios will allow identification of in-state transmission upgrades that would mitigate reliability criteria violations associated with access to large amounts of out-of-state resources or of resources that are presently outside of existing California Balancing Authorities.

The objective of the Northern resource scenario is to identify transmission upgrades that will mitigate reliability criteria violations that may arise if the renewable resource mix from the Generation Interconnection Queue Portfolio for California was changed such that the renewable resources modeled in Northern California or north of California and committed to California load serving entities in Phase 1 were to change from 18% of total required renewable resources to about 42%. For this scenario the COI path flow will be approximately 4,800 MW and the Northern California hydro levels will be at approximately 60% of installed capacity prior to the addition of any renewable resources. In general the suggested amounts of additional renewables to be modeled in the proposed case are as follows:

- Pacific Northwest – 2,000 MW installed capacity of a wind/hydroelectric shaped resource located in the Pacific Northwest connected to Malin/Captain Jack
- Pacific Northwest – 1,500 MW installed capacity of a wind resource located in the Pacific Northwest connected to Malin/Captain Jack
- Northeastern California – 1,000 MW installed capacity, 60% wind and 40% solar, (located in Lassen County)[12] assumed to be interconnected with the COI facilities at Round Mountain and/or Olinda
- Northern Nevada – 1,000 MW installed capacity, 60% wind and 40% geothermal,[13] assumed to be interconnected with the COI facilities at Round Mountain and/or Olinda

For the Northern resource scenario, all in-state renewable resources in Southern California will be decremented on a pro-rata basis to accommodate the additional Northern renewable

[12]Based on projects located in Lassen County in the NV Energy interconnection queue as of January 12, 2010 (see attached) and on expressions of interest to the Lassen Municipal Utility District.
[13]Based on projects located in northern Nevada in the NV Energy interconnection queue as of January 12, 2010.

resources. The resulting MW and GWhs for each CREZ and by technology are included in Table 4.6.

The objective of the Desert Southwest resource scenario is to identify transmission upgrades that will mitigate reliability criteria violations that may arise if the renewable resource mix from the Generation Interconnection Queue Portfolio for California was changed such that the out-of-state renewable resources modeled in the desert southwest and committed to California load serving entities in Phase 1 were to change from 2% of total renewable resources to about 15% of total renewable resources. In general, the suggested amounts of additional renewables to be modeled in the proposed case are as follows:

- Arizona – 1750 MW of solar connected at Palo Verde, Southern Nevada – 1750 MW of solar connected to El Dorado

For the Desert Southwest resource scenario, all in state renewable resources in Southern California will be decremented on a pro-rata basis to accommodate the additional Desert Southwest renewable resources. The resulting MW and GWhs for each CREZ and by technology are included in Table 4.7.

Phase 3 of the CTPG study may address additional sensitivities regarding higher levels of renewable imports or specific new renewable configurations coming from out of state.

2. Owens Valley Portfolio

The objective of the Owens Valley resource scenario is to identify the transmission upgrades that will mitigate reliability criteria violations that may arise if the renewable resource mix from the Generation Interconnection Queue Portfolio for California was changed to add 5000MW of installed capacity of Solar Photovoltaic. For the Owens Valley resource scenario, all in state renewable resources in Southern California will be decremented on a pro-rata basis to accommodate the additional Solar Photovoltaic renewable resources. n a pro-rata basis to accommodate the additional Desert Southwest renewable resources. The resulting MW and GWhs for each CREZ and by technology are included in Table 4.8.

4.4 Renewable Generation Production Profiles

As noted above in Phase 1, CTPG used a combination of sources to establish production profiles for renewable resources. Based on the location of each CREZ, and the mix of renewable resources within each CREZ, CTPG members have developed estimates of the expected energy output of each CREZ for the specific study conditions assumed for the power flow cases. These estimates are based on actual hourly output data for similar technologies in similar locations.[14] In Phase 2, this information has been updated by Black and Veatch to match the energy production profiles currently used by RETI. For study purposes, the CTPG utilizes the expected average capacity factor for that resource type within that CREZ location. In contrast, RETI in

[14]For a review of the production assumptions for each CREZ by renewable technology, see California ISO, "2020 Renewable Transmission Conceptual Plan Based on Inputs from the RETI Process Study Results," September 15, 2009, available at http://www.caiso.com/242a/242ae729af70.pdf .

their calculation utilizes the capacity factors for a specific project within each CREZ for inclusion in their scenario(s). This difference in approach, depending on CREZ location, will result in approximately 5% difference between CTPG and RETI annual energy output calculations. This difference is not considered significant to the comparison of study cases or scenarios.

Wind and solar generation modeled in the studies are represented as fixed production profiles. There is no consideration given in the analysis to dispatch control of renewable resource output (i.e., generation re-dispatch as discussed for fossil units in Section 5.1.), as may ultimately be needed to mitigate over-generation and congestion or ramp constraints on the rest of the generation fleet caused by variable renewable generation. Evaluation of renewable integration requirements will be completed separately by each planning entity.

Table 4.4: Generation Interconnection Queue Portfolio

	Install Capacity (MW)				Dispatched (MW)				Energy (GWh)				
CREZ	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Total
Baja-A (La Rumorosa)	1029	0	0	0	311	0	0	0	2704	0	0	0	2704
Baja-B (Santa Catarina)	0	0	0	0	0	0	0	0	0	0	0	0	
Barstow	0	0	0	0	0	0	0	0	0	0	0	0	
British Columbia	0	0	0	0	0	0	0	0	0	0	0	0	
Carrizo North	0	703	15	0	0	580	13	0	0	1416	116	0	1532
Carrizo South	0	221	7	0	0	184	7	0	0	452	58	0	510
Cuyama	0	37	0	0	0	30	0	0	0	78	0	0	
Fairmont	0	0	0	0	0	0	0	0	0	0	0	0	
Imperial East	0	0	0	0	0	0	0	0	0	0	0	0	
Imperial North-A	0	418	0	0	0	264	0	0	0	901	0	0	901
Imperial North-B	0	0	0	546	0	0	0	491	0	0	0	4305	4305
Imperial South	91	1952	58	0	27	1176	52	0	239	4293	457	0	4990
Inyokern	0	230	0	253	0	169	0	228	0	555	0	1997	2552
Iron Mountain	0	0	0	0	0	0	0	0	0	0	0	0	
Kramer	0	0	0	41	0	0	0	37	0	0	0	326	326
Lassen North	0	0	0	463	0	0	0	417	0	0	0	3652	3652
Lassen South	0	0	0	0	0	0	0	0	0	0	0	0	
Mountain Pass	0	656	0	0	0	432	0	0	0	1475	0	0	1475
Needles	0	0	0	0	0	0	0	0	0	0	0	0	
Nevada C	0	0	0	57	0	0	0	51	0	0	0	449	449
Nevada N	0	487	0	0	0	359	0	0	0	1127	0	0	1127
Oregon	0	0	0	0	0	0	0	0	0	0	0	0	
Owens Valley	0	184	0	0	0	114	0	0	0	399	0	0	399
Palm Springs	183	0	0	0	103	0	0	0	624	0	0	0	624
Pisgah	0	781	0	0	0	583	0	0	0	1867	0	0	1867

Riverside East	0	2527	0	0	0	1644	0	0	0	5615	0	0	5615
Round Mountain-A	94	0	0	0	22	0	0	0	253	0	0	0	253
Round Mountain-B	0	0	0	0	0	0	0	0	0	0	0	0	
San Bernardino - Baker	0	0	0	0	0	0	0	0	0	0	0	0	
San Bernardino - Lucerne	0	0	0	0	0	0	0	0	0	0	0	0	
San Diego North Central	0	24	0	0	0	15	0	0	0	51	0	0	51
San Diego South	332	0	0	0	108	0	0	0	939	0	0	0	939
Santa Barbara	110	0	0	0	37	0	0	0	299	0	0	0	299
Solano	555	0	0	32	362	0	0	29	1699	0	0	254	1953
Tehachapi	3667	1966	0	0	2216	1460	0	0	10799	4598	0	0	15397
Twentynine Palms	0	0	0	0	0	0	0	0	0	0	0	0	
Victorville	74	238	0	0	21	179	0	0	196	572	0	0	768
Total	**6135**	**10425**	**80**	**1393**	**3208**	**7190**	**72**	**1254**	**17750**	**23400**	**631**	**10983**	**52764**

Table 4.5: RETI Heavy In-State Portfolio

	Installed Capacity (MW)				Dispatched (MW)				Energy (GWh)				
CREZ	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Total
Baja-A (La Rumorosa)	0	0	0	0					0	0	0	0	0
Baja-B (Santa Catarina)	0	0	0	0					0	0	0	0	0
Barstow	0	0	0	0					0	0	0	0	0
British Columbia	0	0	0	0					0	0	0	0	0
Carrizo North	0	0	0	0					0	0	0	0	0
Carrizo South	0	760		0					0	1616	0	0	1616
Cuyama	0	0	0	0					0	0	0	0	0
Fairmont	295	746	57	0					826	1672	405	0	2903
Imperial East	0	0	0	0					0	0	0	0	0
Imperial North-A	0	49	0	568					0	168	0	4186	4354
Imperial North-B	0	0	0	0					0	0	0	0	0
Imperial South	0	300	0	0					0	648	0	0	648
Inyokern	0	0	0	0					0	0	0	0	0
Iron Mountain	0	0	0	0					0	0	0	0	0
Kramer	84	2565	0	10					186	5878	0	66	6130
Lassen North	0	0	0	0					0	0	0	0	0
Lassen South	0	0	0	0					0	0	0	0	0
Mountain Pass	0	310	0	0					0	800	0	0	800
Needles	0	0	0	0					0	0	0	0	0
Nevada C	0	0	0	0					0	0	0	0	0
Nevada N	0	0	0	0					0	0	0	0	0
Oregon	0	0	0	0					0	0	0	0	0
Owens Valley	0	0	0	0					0	0	0	0	0
Palm Springs	37	0	0	0					118	0	0	0	118
Pisgah	0	500	0	0					0	1047	0	0	1047

Riverside East	0	0	0	0					0	0	0	0	0
Round Mountain-A	0	0	0	159					0	0	0	1060	1060
Round Mountain-B	103	0	0	0					303	0	0	0	303
San Bernardino - Baker	0	0	0	0					0	0	0	0	0
San Bernardino - Lucerne	42	0	0	0					96	0	0	0	96
San Diego North Central	0	0	0	0					0	0	0	0	0
San Diego South	281	0	20	0					759	0	158	0	917
Santa Barbara	83	0	0	0					280	0	0	0	280
Solano	0	2	0	0					0	5	0	0	5
Tehachapi	2921	2984	0	15					8763	6674	109	0	15546
Twentynine Palms	0	0	0	0					0	0	0	0	0
Victorville	0	0	0	0					0	0	0	0	0
Westlands	0	0	0	0					0	0	0	0	0
Out of State													
Arizona	432	1530	37	0					1133	3722	259	0	5114
Baja	0	0	0	0					0	0	0	0	0
British Columbia	0	0	0	0					0	0	0	0	0
Idaho	582	0	42	38					1795	0	283	249	2327
New Mexico	0	0	0	0					0	0	0	0	0
Nevada	0	448	15	160					0	1246	108	1098	2452
Oregon	1244		48	47					3216		332	335	3883
Utah	195	0	10	44					517		73	293	883
Washington	379	0	57	0					999	0	389	0	1388
Wyoming	0	0	0	0					0	0	0	0	0
CA Non CREZ	0	61	72	0					0	300	594	0	894
Total	**6678**	**10255**	**358**	**1041**					**18991**	**23776**	**2710**	**7287**	**52764**

Table 4.6: Northern Portfolio

	Installed Capacity (MW)				Dispatched (MW)				Energy (GWh)				
CREZ	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	TOTAL
Baja-A (La Rumorosa)	315	0	0	0	95	0	0	0	826	0	0	0	826
Baja-B (Santa Catarina)	0	0	0	0	0	0	0	0	0	0	0	0	
Barstow	0	0	0	0	0	0	0	0	0	0	0	0	
British Columbia	2040	0	0	0	1082	0	0	0	8353	0	0	0	8353
Carrizo North	0	409	9	0	0	337	8	0	0	823	68	0	891
Carrizo South	0	128	4	0	0	107	4	0	0	263	34	0	297
Cuyama	0	11	0	0	0	9	0	0	0	24	0	0	
Fairmont	0	0	0	0	0	0	0	0	0	0	0	0	
Imperial East	0	0	0	0	0	0	0	0	0	0	0	0	
Imperial North-A	0	128	0	0	0	81	0	0	0	275	0	0	275
Imperial North-B	0	0	0	167	0	0	0	150	0	0	0	1315	1315
Imperial South	28	597	18	0	8	359	16	0	73	1312	140	0	1525
Inyokern	0	70	0	77	0	52	0	70	0	170	0	610	780
Iron Mountain	0	0	0	0	0	0	0	0	0	0	0	0	
Kramer	0	0	0	13	0	0	0	11	0	0	0	100	
Lassen North	828	238	0	418	190	143	0	376	2144	1253	0	3296	6693
Lassen South	0	0	0	0	0	0	0	0	0	0	0	0	
Mountain Pass	0	201	0	0	0	132	0	0	0	451	0	0	451
Needles	0	0	0	0	0	0	0	0	0	0	0	0	
Nevada C	0	0	0	17	0	0	0	16	0	0	0	137	137
Nevada N	0	149	0	0	0	110	0	0	0	344	0	0	344
Oregon	0	0	0	0	0	0	0	0	0	0	0	0	
Owens Valley	0	56	0	0	0	35	0	0	0	122	0	0	122
Palm Springs	56	0	0	0	32	0	0	0	191	0	0	0	191
Pisgah	0	239	0	0	0	178	0	0	0	571	0	0	571
Riverside East	0	772	0	0	0	502	0	0	0	1716	0	0	1716

Round Mountain-A	55	0	0	0	13	0	0	0	147	0	0	0	147
Round Mountain-B	0	0	0	0	0	0	0	0	0	0	0	0	
San Bernardino - Baker	0	0	0	0	0	0	0	0	0	0	0	0	
San Bernardino - Lucerne	0	0	0	0	0	0	0	0	0	0	0	0	
San Diego North Central	0	7	0	0	0	5	0	0	0	16	0	0	
San Diego South	101	0	0	0	33	0	0	0	287	0	0	0	287
Santa Barbara	34	0	0	0	11	0	0	0	91	0	0	0	91
Solano	170	0	0	10	110	0	0	9	519	0	0	78	597
Tehachapi	1120	601	0	0	677	446	0	0	3301	1405	0	0	4706
Twentynine Palms	0	0	0	0	0	0	0	0	0	0	0	0	
Victorville	22	73	0	0	6	55	0	0	60	175	0	0	235
Subtotal	4768	3679	31	702	2258	2551	28	632	15992	8919	242	5536	30550
Northwest	1508	0	0	0	360	0	0	0	4062	0	0	0	4062
Northern CA	1423	410	0	255	327	246	0	229	3687	2155	0	2010	7852
Northwest Shaped													10300
Total	**7699**	**4089**	**31**	**957**	**2945**	**2797**	**28**	**861**	**23741**	**11074**	**242**	**7546**	52764

Table 4.7: Desert Southwest Portfolio

	Installed Capacity (MW)				Dispatched (MW)				Energy (GWh)				
CREZ	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Total
Baja-A (La Rumorosa)	1029	0	0	0	311	0	0	0	2704	0	0	0	2704
Baja-B (Santa Catarina)	0	0	0	0	0	0	0	0	0	0	0	0	
Barstow	0	0	0	0	0	0	0	0	0	0	0	0	
British Columbia	0	0	0	0	0	0	0	0	0	0	0	0	
Carrizo North	0	703	15	0	0	580	13	0	0	1416	116	0	1532
Carrizo South	0	221	7	0	0	184	7	0	0	452	58	0	510
Cuyama	0	37	0	0	0	30	0	0	0	78	0	0	78
Fairmont	0	0	0	0	0	0	0	0	0	0	0	0	
Imperial East	0	0	0	0	0	0	0	0	0	0	0	0	
Imperial North-A	0	334	0	0	0	211	0	0	0	719	0	0	719
Imperial North-B	0	0	0	436	0	0	0	392	0	0	0	3436	3436
Imperial South	73	1485	46	0	22	939	42	0	191	3427	365	0	3983
Inyokern	0	183	0	24	0	135	0	22	0	443	0	190	633
Iron Mountain	0	0	0	0	0	0	0	0	0	0	0	0	
Kramer	0	0	0	33	0	0	0	30	0	0	0	260	260
Lassen North	0	0	0	463	0	0	0	417	0	0	0	3652	3652
Lassen South	0	0	0	0	0	0	0	0	0	0	0	0	
Mountain Pass	0	524	0	0	0	345	0	0	0	1178	0	0	1178
Needles	0	0	0	0	0	0	0	0	0	0	0	0	
Nevada C	0	0	0	57	0	0	0	51	0	0	0	449	449
Nevada N	0	487	0	0	0	359	0	0	0	1127	0	0	1127
Nevada S	0	0	0	223	0	0	0	201	0	0	0	1759	1759
Oregon	0	0	0	0	0	0	0	0	0	0	0	0	
Owens Valley	0	147	0	0	0	91	0	0	0	318	0	0	318
Palm Springs	146	0	0	0	82	0	0	0	498	0	0	0	498
Pisgah	0	624	0	0	0	465	0	0	0	1490	0	0	1490

Riverside East	0	2017	0	0	0	1312	0	0	0	4482	0	0	4482
Round Mountain-A	94	0	0	0	22	0	0	0	253	0	0	0	253
Round Mountain-B	0	0	0	0	0	0	0	0	0	0	0	0	
San Bernardino - Baker	0	0	0	0	0	0	0	0	0	0	0	0	
San Bernardino - Lucerne	0	0	0	0	0	0	0	0	0	0	0	0	
San Diego North Central	0	19	0	0	0	12	0	0	0	41	0	0	41
San Diego South	265	0	0	0	86	0	0	0	749	0	0	0	749
Santa Barbara	88	0	0	0	29	0	0	0	239	0	0	0	239
Solano	555	0	0	32	362	0	0	29	1699	0	0	254	1953
Tehachapi	2926	1569	0	0	1769	1165	0	0	8618	3670	0	0	12288
Twentynine Palms	0	0	0	0	0	0	0	0	0	0	0	0	
Victorville	59	190	0	0	17	143	0	0	156	457	0	0	613
Arizona	0	1750	0	0	0	1139	0	0	0	7822	0	0	3888.3
Southern Nevada	0	1750	0	0	0	1152	0	0	0		0	0	3934
Total	**5234**	**12038**	**69**	**1269**	**2701**	**8262**	**61**	**1142**	**15106**	**27119**	**539**	**10000**	**52764**

Table 4.8: Owens Valley Portfolio

	Install Capacity (MW)				Dispatched (MW)				Energy (GWh)				
CREZ	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Wind	Solar Th.	Bio	Geo	Total
Baja-A (La Rumorosa)	1029	0	0	0	311	0	0	0	2703	0	0	0	2703
Baja-B (Santa Catarina)	0	0	0	0	0	0	0	0	0	0	0	0	
Barstow	0	0	0	0	0	0	0	0	0	0	0	0	
British Columbia	0	0	0	0	0	0	0	0	0	0	0	0	
Carrizo North	0	703	15	0	0	580	13	0	0	1416	117	0	1533
Carrizo South	0	221	7	0	0	184	7	0	0	452	58	0	510
Cuyama	0	36	0	0	0	30	0	0	0	76	0	0	
Fairmont	0	0	0	0	0	0	0	0	0	0	0	0	
Imperial East	0	0	0	0	0	0	0	0	0	0	0	0	
Imperial North-A	0	295	0	0	0	186	0	0	0	634	0	0	634
Imperial North-B	0	0	0	384	0	0	0	346	0	0	0	3031	3031
Imperial South	64	1375	41	0	19	828	37	0	168	3024	322	0	3514
Inyokern	0	162	0	244	0	119	0	220	0	391	0	1927	2318
Iron Mountain	0	0	0	0	0	0	0	0	0	0	0	0	
Kramer	0	0	0	29	0	0	0	26	0	0	0	230	230
Lassen North	0	0	0	463	0	0	0	417	0	0	0	3653	3653
Lassen South	0	0	0	0	0	0	0	0	0	0	0	0	
Mountain Pass	0	462	0	0	0	304	0	0	0	1039	0	0	1039
Needles	0	0	0	0	0	0	0	0	0	0	0	0	
Nevada C	0	0	0	57	0	0	0	51	0	0	0	449	449
Nevada N	0	487	0	0	0	359	0	0	0	1127	0	0	1127
Oregon	0	0	0	0	0	0	0	0	0	0	0	0	
Owens Valley	0	129	0	0	0	81	0	0	0	281	0	0	281
Palm Springs	129	0	0	0	73	0	0	0	439	0	0	0	439
Pisgah	0	550	0	0	0	410	0	0	0	1315	0	0	1315

Riverside East	0	1780	0	0	0	1158	0	0	0	3954	0	0	3954
Round Mountain-A	94	0	0	0	22	0	0	0	253	0	0	0	253
Round Mountain-B	0	0	0	0	0	0	0	0	0	0	0	0	
San Bernardino - Baker	0	0	0	0	0	0	0	0	0	0	0	0	
San Bernardino - Lucerne	0	0	0	0	0	0	0	0	0	0	0	0	
San Diego North Central	0	17	0	0	0	11	0	0	0	36	0	0	36
San Diego South	234	0	0	0	76	0	0	0	661	0	0	0	661
Santa Barbara	78	0	0	0	26	0	0	0	211	0	0	0	211
Solano	579	0	0	32	377	0	0	29	1772	0	0	254	2026
Tehachapi	2582	1385	0	0	1561	1028	0	0	7605	3238	0	0	10843
Twentynine Palms	0	0	0	0	0	0	0	0	0	0	0	0	
Victorville	52	168	0	0	15	126	0	0	138	403	0	0	541
Sub Total	4841	7769	63	1211	2480	5404	57	1089	13950	17386	497	9544	41376
Owens Valley PV	0	5000	0	0	0	2950	0	0	0	11388	0	0	11388
TOTAL	**4841**	**12769**	**63**	**1211**	**2480**	**8354**	**57**	**1089**	**13950**	**28774**	**497**	**9544**	**52764**

5 Generation Re-Dispatch

5.1 Reduction Priority

As renewable generation production is increased, an equal amount of fossil fueled generation is required to be turned down (or decremented). Fossil generation was selected for reduction because of economics. With renewable generation mandated to occupy 33% of the electricity market in California, fossil generation must compete to remain in the market. The least efficient fossil units will be the most likely to shut down by 2020. Phase 1 studies used heat rate as the basis for reduction priority with high heat rate units backing down first. Generally, high heat rate translates into higher cost to produce electricity. CTPG will continue utilizing this methodology in Phase 2.

Another method to determine reduction priority is based on minimizing the carbon footprint, i.e., turn down units with the highest carbon emissions per megawatt-hour. Currently, legislation is being considered that would impose a carbon tax on fossil generation such that owners would need to make an economic decision whether to pay the tax and continue to operate, implement technical measures to reduce carbon emissions or retire the units. While there are many possible legislative methods to implement a carbon footprint minimization objective, none have been enacted.

CTPG will make an initial effort to simulate a carbon footprint minimization strategy using fuel type as a proxy. Obtaining timely carbon emissions data for power plants throughout the WECC was not feasible for Phase 2 however fuel type can be used as an approximation. Existing coal generation has the highest carbon footprint and under nearly any potential minimization strategy would be the first set of units to be decremented followed by oil and gas units. Within each fuel type the reduction priority will be based on heat rate. Heat rate is a measure of efficiency, generators using the same fossil fuel can be ranked to estimate which units are likely to produce more green house gases. A high heat rate would imply the burning of more fuel and therefore more emissions. This is only an approximation since the emission controls and the specific type of coal burned can be significant factors in determining green house gas emissions. Recrementing based on fossil fuel type can be a proxy for reduction by carbon footprint until more data is available.[15]

Some fossil generation because of their location (i.e. must run or local capacity requirement) may provide local benefits which can override economic considerations. Renewable integration during real time operations may also require more fossil generation to remain on-line to address intermittency issues. Fossil generation developed as peakers may also remain in the generation fleet though they typically have higher heat rates. Although these are significant elements in precisely predicting which particular set of generators will be shut down by 2020 they may not

[15] We also note that stakeholders have proposed using a carbon tax to effect carbon reductions in the re-dispatch. One of the difficulties in this approach is deciding the level of the tax; to re-dispatch coal plants, such a tax would have to be sufficiently high. Nevertheless, this could be an alternative approach to emissions rates, although one that presumably would reach similar results.

be critical in the determination of the transmission upgrades required to meet a 33% RPS. The location of the renewable generation rather than the corresponding decremented fossil generation is a more significant factor in determining where reliability criteria violations are very likely to occur and the set of "least regret" transmission additions that will mitigate the violations.

5.2 In State/Out of State

Phase 1 employed a 70/30 constraint in the reduction of fossil generation. Seventy percent of the decremented generation is located within California with thirty percent located outside the state. Phase 2 will continue with this assumption for both the heat rate and fuel type methods. Phase 3 may investigate other ratios.

CTPG recognizes that minimizing the carbon footprint may require a WECC wide approach. For example, a national carbon tax would apply equally to all fossil generation plants in the United States. If the carbon tax was sufficiently high, coal fired generation would cost more than other types of fossil generation and imposing an in/out of state constraint on the amount of coal fired generation that is decremented in response to the addition of renewable generation would not be coherent under a national carbon tax.

Decrementing coal fired generators outside of California to accommodate increased renewable generation within California could, for the first time, make California a net exporter of energy. This scenario may give rise to transmission reliability criteria violations entirely outside the state of California. Since CTPG is a California centric forum the identification of transmission constraints outside California has not been a priority. If there is sufficient stakeholder interest such a scenario may be considered in Phase 3.

Methods

Although Phase 2 will continue to primarily utilize the heat rate method to reduce the output of fossil generation, select scenarios will also employ a fuel type method to gauge the sensitivity in changing the required transmission additions. The following provides a description of these two methods to be employed in Phase 2.

1. Heat Rate. Fossil generation is decremented in a merit-order fashion (least economic reduced first). This merit order was established through the use of heat rate data obtained from the WECC Transmission Expansion Planning & Policy Committee's (TEPPC's) 2017 economic database. A 70/30 (in/out of state) constraint is imposed for this method.

   Table 5 shows an example of the fossil generation decremented to offset the first block of renewable generation. This particular block is split 70/30 between units in California and those outside the state. Units in the block are decremented equally until all units in the block are turned off. Decrements below minimum output level are not allowed; i.e., the unit is turned off. Units in the next block are then reduced in the same fashion.

Nuclear and hydro units are not decremented in the summer peak cases but could be reduced for the off peak cases.

Table 5: Fossil Generation Decrement Example - First Block

Internal (In California)			
Name	**Unit**	**Nameplate (MW)**	**FL H.R. (mmBtu/MWh)**
Mandalay	3	130	16.065
Ellwood	1	54	15.125
Olive	1	44	13.953
Long Beach	1	65	13.106
Long Beach	2	65	13.106
Long Beach	3	65	13.106
Long Beach	4	65	13.106
RAMCO OY	1	42	13.009
Grayson	8b	70	13.009
Goose	2	48	13.009
Lambie	1	48	13.009
	Total	**696 MW**	

External (Out of State)			
Name	**Unit**	**Nameplate (MW)**	**FL H.R. (mmBtu/MWh)**
Ocotillo GT1	1	56	14
Ocotillo GT2	1	56	14
Yucca CT1	1	19	14
Yucca CT2	1	19	14
WPhx GT1	1	56	14
WPhx GT2	1	56	14
Reeves	1	40	13.613
	Total	**302 MW**	

2. Fuel Type. This method employes an approximation for determining which fossil generators will be decremented to minimize carbon emissions. This proxy method reduces generators based on fuel type. First to be decremented will be coal generators followed by oil and gas units. Within each fuel type the units with the highest heat rate is backed down first. Blocks of fossil generation are decremented to offset new renewable generation. Units in the block are decremented equally until all units in the block are turned off. Decrements below minimum output level are not allowed; i.e., the unit is turned off. Units in the next block are then reduced in the same fashion. A 70/30 (in/out of state) constraint is imposed for this method.

6 Methodology comparison to RETI

As noted above, transmission planning generally consists of three main elements: an estimate of the load that is expected in the planning horizon; modeling of the supply resources that are, or will be, interconnected to the transmission grid; and identification of alternative transmission facilities (upgraded or new transmission lines, substations, and so on) that can meet reliability, economic and policy objectives, such as RPS. The planning methodologies used to model future power system requirements can also vary.

At the request of stakeholders, this section compares the planning assumptions and methodologies used in the CTPG Phases 1 and 2 with those used by RETI in their Phase 2A report. As noted in the prior CTPG study plans and reports, there are both similarities and differences between the CTPG and the RETI Phase 2A assumptions and methodology. This CTPG Phase 2 study plan reflects a further convergence in CTPG and RETI approaches, in that RETI has provided the estimates of future net load and renewable resource portfolio as inputs, while CTPG is conducting the transmission modeling.

6.1 Transmission System Analysis

One basic difference between the RETI Phase 2A transmission analysis and the CTPG approach is the level of transmission modeling used. RETI Phase 2A used input from RETI participants, including CTPG members, to identify potential transmission upgrades. However, this input did not have the benefit of power flow and transient analysis. RETI performed a "generation shift factor" analysis to determine the transmission needs for their proposed renewable resource plan. In contrast, the CTPG is performing power flow and transient analysis that is significantly more accurate at measuring the electric system performance and for determining transmission system needs.

There was some overlap between the transmission additions included in the RETI Phase 2A conceptual transmission plan and those identified in CTPG's Phase 1 conceptual transmission plan (see the draft 2010 Phase 1 CTPG 2020 Study Report for a comparison table of RETI Phase 2A and CTPG Phase 1 transmission elements).[16] This results in a smaller set of transmission elements than identified by RETI. CTPG studies will continue to provide those comparisons.

6.2 Net Short and Input Assumptions

When comparing CTPG Phase 1 to the RETI Phase 2A, both studies utilized CEC sources for the forecast of retail energy sales for the state. CTPG and RETI differed slightly in the estimates of expected renewable resources additions by the end of 2009. RETI Phase 2A also assumed that 160% of the renewable energy needed to achieve the 33% RPS should be modeled to account for potential uncertainties. The CTPG has instead identified sufficient renewable resources to achieve 33% RPS and then identified transmission elements that would mitigate identified reliability criteria violations with this amount of installed renewable generating capacity.

In terms of resources modeled, RETI Phase 2A developed its estimates based on economically feasible renewable development potential, rather than an actual commercial interest in that potential. In addition RETI considered out-of-state renewable resource development potential

[16] Available at http://www.ctpg.us/public/images/stories/pdfs/2010_phase_1_ctpg_2020_study_report_011310.pdf .

in British Columbia, Washington, Oregon, Nevada, Arizona and Baja. As is evident from the data collected by the CTPG in its Phase 1, California load serving entities' plans include adding renewable resources located in Idaho and Montana.

In CTPG Phase 2, as discussed above, CTPG and RETI have converged in that they have agreed to use a common "net short" estimate. Also CTPG will begin modeling updated RETI renewable generation portfolios that, unlike Phase 2A, will be restricted to MW of renewable capacity needed to achieve a 33% renewable energy target.